

Looking at the World Differently: Technology-based Solutions to Global Problems of Aging Populations[‡]

PRESENTED BY
Gerold Yonas, Ph.D.
Vice President and Principal Scientist
Sandia National Laboratories[†]
Albuquerque, NM 87185
USA
with
Jessica Glicken Turnley, Ph.D.
Galisteo Consulting Group, Inc.
Albuquerque, NM 87110
USA
Judy Moore, Ph.D., Richard Craft, M.S.
Sandia National Laboratories
Albuquerque, NM 87185
USA

Youth is not a time of life; it is a state of mind, it is not a matter of rosy cheeks, a quality of the imagination, a vigor of the emotions; it is the freshness of the deep springs of life. Youth means the temperamental predominance of courage over timidity, of the appetite for adventure over the love of ease. This often exists in a man of sixty more than a boy of twenty. Nobody grows old merely by a number of years. We grow old by deserting our ideals. Years may wrinkle the skin, but to give up enthusiasm wrinkles the soul. Worry, fear, self-distrust bows the heart and turns the spirit back to dust. Whether sixty or sixteen, there is in every human being's heart the lure of wonder, the unfailing childlike appetite of what's next, and the joy of the game of living. In the center of your heart and my heart there is a wireless station; so long as it receives messages of beauty, hope, cheer, courage and power from men and from the Infinite, so long are you young. When the aeriels are down, and your spirit is covered with snows of cynicism and the ice of pessimism, then you are grown old, even at twenty, but as long as your aeriels are up, to catch waves of optimism, there is hope you may die young at eighty.

Konosuke Matsushita

[‡] This discussion is based on a paper by Judy Moore, Elaine Raybourn, and Jessica Turnley titled *Promoting the Wellness Model of Elderly Health Care through Technology and Social Support* at the Society of Women Engineers annual meeting, Denver, CO, June 2001.

[†] Sandia is a multiprogram laboratory operated by Sandia Corporation, A Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94-AL85000.

Abstract - *At the policy summit of the CSIS Global Aging Initiative in January of 2001, the problem of global aging was generally cast as a supply and demand problem. On the supply side, four “pillars” of a sustainable pension system were identified. The first three involved ways to use the current workforce to enhance or sustain the supply of funds, while the fourth pillar looked at ways to increase the supply through the enablement of longer and more productive work lives for the elderly, through increases in the work force in general by the inclusion of new segments such as women or younger workers, or through selective immigration or increased birth rates.*

In this paper, we consider the consumption portion of the supply-demand equation. We suggest that regardless of changes in supply or demand, changing the ways in which services are provided and consumed will enable the elderly to have the quality of life we ourselves would like to enjoy in their place. Specifically, we propose that some technologies can reduce the need to consume, improve the efficiency of consumption, and/or reduce the cost of delivering a benefit. We then give examples of ways in which technology can be used under the wellness model of health care to change consumption patterns by changing consumer and caregiver behavior, and in some cases, by changing the service provided while retaining or enhancing the benefit received.

Introduction – The Challenge

The population of the United States is aging. On January 1, 2011, the first of the “baby boomers” will turn 65 years old. By 2023, roughly 20 percent of our nation will be over age 65, giving us a look similar to Florida today [1]. This January 1, 2011, birthday marks the beginning of our nation’s newest challenge: keeping our elders engaged in our communities in ways that make their lives satisfying to them while they continue to make real social contributions. This, of course, must be accomplished without consuming the national treasury. In short, we must find a way to keep our elders young, in Matsushita’s sense, without bankrupting current and future generations.

As people age, they change physically and mentally. Currently, the elderly are largely excluded from the workforce, some by choice, some by social expectations, but many by physical or mental barriers. Many undergo significant lifestyle changes as these physical and mental changes increasingly reduce their ability to care for themselves in areas ranging from driving or shopping, to dressing and feeding. These individuals must be cared for by others, either by family or through paid support.

The aging of the population will have significant economic and political implications for our society and for our national future. The elderly will support different social programs than their middle-aged children, changing the pattern of the federal budget. Their voting behaviors and other aspects of political participation may change as they become less able to access information. Finally we must bear the cost of the care and maintenance of this elderly population—a cost that will be borne by a workforce that is growing proportionally smaller relative to the supported population.

At our meeting in Zurich, “Managing the Global Aging Transition,”[2] the conversations generally cast the problem of our nations’ aging populations as this sort of a supply and demand problem. On the supply side, conference participants identified four “pillars” of a sustainable pension system. The first three involved ways to use the current workforce to enhance or sustain the supply of funds: a taxation funded pay-as-you-go approach; a funded liability approach; and an approach based on government-encouraged personal savings. The fourth pillar looked at ways to increase the supply through the enablement of longer and more productive work lives for the elderly, and through increases in the work force in general by the inclusion of new segments such as women or younger workers, or through selective immigration or increased birthrates. Some of the presentations proposed solutions based on demand-reducing techniques such as delays in benefit disbursements or reductions in benefits offered.

Refining the Fourth Pillar

We propose a refined view of the fourth pillar by considering the consumption portion of the supply-demand equation. We suggest that regardless of changes in supply or demand, changing the ways in which services are provided and consumed will enable the elderly to have the quality of life we, ourselves, would like to enjoy in their place.

In the following discussion, we will look at ways in which technologies of various kinds—some existing, many not yet invented—can impact the consumption of goods and services. Specifically, we will look at ways in which these technologies can *reduce the need to consume, improve the efficiency of consumption, and reduce the cost of delivering a benefit.*

“Years may wrinkle the skin, but to give up enthusiasm wrinkles the soul.”

Of the many the problems surrounding the aging of our population, we choose to address the health of the elderly and the enormous social and financial costs associated with it. We will explore the way in which our society thinks about healthcare and how those paradigms affect the provision of services and the consumption of benefit. While we cannot stop chronological progression, we can have an impact on the physiological and associated psychological changes associated with aging. We also can influence how we are socially organized to care for our elderly.

We will focus on an emergent model of care for the elderly that is based on a wellness, rather than a medical, paradigm of care. We will show how technology can be incorporated into social interventions and mechanisms of care for the elderly under this new model or paradigm. This paradigm allows us to use technology to *enhance* or *leverage*, not *replace*, the human dimension of care, significantly extending our ability to care for this group and improve the quality and cost-effectiveness of care provided. It will result in a psychologically healthy elderly population that is both capable of and interested in continued social contributions.

We begin with an exposition of the wellness and medical models of care. We will then give examples of ways in which technology can be used under the wellness model to change consumption patterns by changing consumer and caregiver behavior, and in some cases, by changing the service provided while retaining or enhancing the benefit received.

Paradigms of Care

Two paradigms underlie today's efforts to maintain the health of the elderly. One is a medical paradigm based on a crisis management approach. Under this model, we intervene only if an individual's health is critically impaired. Historically the medical paradigm has focused almost exclusively on physiological aspects of health. The wellness paradigm, an alternative approach, focuses attention on *maintaining* health. This approach emphasizes prevention, intervening before deterioration has taken place to maintain a healthy state and avoid crisis. Wellness approaches traditionally take a holistic approach to care, considering psychological and social dimensions of health, in addition to the physiological.

The medical paradigm is dominant in our society today, setting national research agendas, defining budgets for support for the elderly, and structuring social systems of payment for care. Implementation of this model is heavily dependent on technology. It is highly "scientific" in its method, approach, and evaluation of results. The wellness paradigm is of growing interest in the United States but presently has much less influence than the medical model. As such, it also has a much weaker impact on research budgets and the design of pay and reimbursement mechanisms. Also it is much less technology-dependent. It relies much more on social support mechanisms than does the medical model and has traditionally been less rigorous in its application of interventions and evaluation of results. We propose that the wellness paradigm, with appropriate technology, has the potential to significantly improve the cost-effectiveness of health care.

The Medical Model

The medical model is, as noted above, crisis-based and remediation-focused in its methodology, and biological in its tools and outlook. The model is based on certain assumptions: that there are certain physiological indicators of "health;" that we know what these are; that we know how to measure them; that we know the boundaries within which normal performance falls; that we know the consequences of performance outside those normal bounds. A patient presents a set of symptoms, a syndrome. The medical community knows (albeit imperfectly) the relationship between certain symptoms or indicators and physiological malfunctioning. Measurements of these indicators are taken. The physician makes extrapolations to physiological function and determines the extent of malfunction. A chemical or physical (surgical) intervention is performed to bring functions back to the norm. The physician evaluates these functions through measurement and comparison to norms.

Our national investment is heavily weighted toward payment for "fixing" problems. In their forward looking document, "MHS 2025 – Toward a New Enterprise," the Military Health System notes that "roughly 90% of the variance in illness and premature death is related to factors other than access to medical treatment. Yet 99% of our total investment in health goes to medical treatment. Public health, health promotion, and disease prevention receive only 1% of total funding." [3] Under a medical model, the goal of the activity is remediation (to "fix" or correct something that is malfunctioning). Action is taken only upon clear indication of malfunction (the patient presents symptoms). This is in clear contrast to a wellness model.

The Wellness Model

The wellness model is focused on prevention and maintenance rather than remediation and tends to be crisis-avoidant in nature. There are many variations of a “wellness model,” but the holistic nature of these approaches and the kinds of issues addressed are very similar. To give a flavor of these, we will use the model of one of the founders of the National Wellness Institute, Dr. Bill Hettler, who described the six dimensions of wellness: social, occupational, spiritual, physical, intellectual, and emotional. [4]

Patient psychological state (usually self-assessed) and an “objective” assessment of social situation play a much bigger role in interventions under a wellness model than under a medical model. Most wellness models recognize the impact of social context on psychological state and therefore on physiological health.

As in the medical model, a baseline state of physiological health is established in the wellness model. Rather than waiting for deviance from the baseline, however, the wellness model stimulates action that promotes *adherence* to the baseline; that is, it *prevents* the deviance that triggers the application of the medical model. Because most variants of the wellness model also explicitly recognize the impact of psychological state and social context on physiological health, treatment or intervention regimes are socially and psychologically as well as biologically based.

Technology and Wellness—Changing the Nature of Consumption

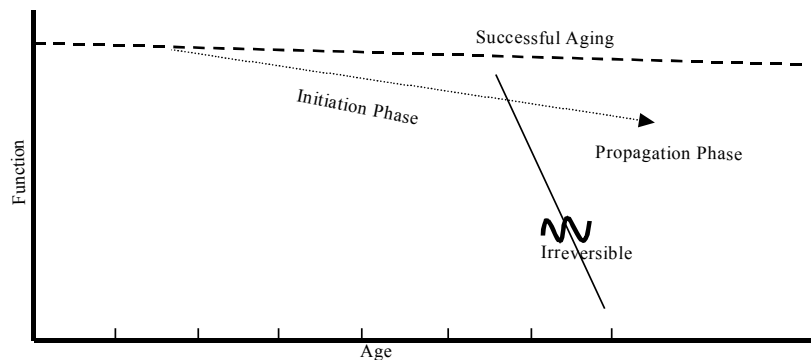
Current treatment and intervention regimes under a wellness paradigm generally require heavy investment in human capital. We recognize that there are certain dimensions of care—reassurance, for example—that require the “human touch.” However, other benefits provided such as information collection on baseline physiological indicators could be delivered through technological devices. We recognize that the examples we give below of possible technologies all depend upon sensitivity to the social and cultural contexts within which they are deployed for successful implementation. In short, we are *not* proposing to take the “people” out of health care for the elderly. To the contrary—we are proposing ways in which the “people” dimension of care can be maximized.

We envision three ways in which technology-based delivery methods can significantly change the nature of the consumption of care by the elderly. The first directly supports the wellness model by *reducing the need to consume*. Technologies in this category center around prevention. They address the maintenance of physiological health as well as social engagement and the psychological health that results from it. The second category of technologies *improves the efficiency of consumption*. Here we include technologies that create more informed consumers, or that reduce the need for extensive travel on the part of the patient in order to receive care. The third category looks at technologies that package the benefit more efficiently to *reduce the cost of the benefit*. Assistive cognitive devices tailored to the needs of individuals are included here, as are patient-centric models of medical delivery that require new technologies for testing and/or drug administration.

Reducing the need to consume

That aging will lead to cognitive and physical decline is a certainty none of us can avoid. Over time, this decline will require the use of healthcare resources to repair or mitigate what goes wrong with us. While none of us can avoid this decline altogether, numerous examples show that we can take steps to slow the rate of decline, and in some cases, avoid certain aspects of this decline altogether. Supporting this claim is recent medical research finding strong links between the physiology of the brain and cognitive function.

As indicated by the graph below [5], the mind of an elderly person may not decline gradually but in distinct phases. While a gradual decline over the years would characterize “successful aging,” researchers are beginning to believe that if steps are taken during the “initiation phase” of certain conditions, such as Alzheimer’s, that the more accelerated decline associated with the conditions can be mitigated and even reversed. Failure to act, however, is thought to lead eventually to a final phase of rapid decline from which there is likely no recovery. Research indicates that exercise, environment enrichment, and proper diet (in particular caloric restriction and increased antioxidants) are successful interventions.



Technology can be used directly by the elderly to enrich their daily environment. This approach follows the wellness paradigm, which assumes that quality of life as well as physiological well being will be enhanced through social stimulation and mental stability. Technology can contribute in this arena through current-day applications such as email and chat rooms, as well as more advanced applications such as “e-sage-ing” (explained below) and remote relationships. It seems that this kind of technology can enhance one’s ability to engage in life experiences.

Generations Online is an independent learning environment that promotes computer-mediated intergenerational communication. [6] In a mini-browser environment, seniors learn to use a mouse, surf the Internet, search the WWW, and communicate asynchronously with 8 to 10 year-olds on the subject of memories. The asynchronous bulletin board allows seniors and kids to post questions and answers about the past. The interaction between the youth and the seniors becomes part of the classroom curriculum.

“Whether sixty or sixteen, there is in every human being’s heart the lure of wonder, the unfailing childlike appetite of what’s next, and the joy of the game of living.”

E-sage-ing, on the other hand, is a real-time discovery process that can occur between youth and elderly in an electronic environment. The term “sage-ing,” coined by Zalman Schachter-Shalomi, refers to a model of late-life development that enables older people to become spiritually radiant, physically vital and socially responsible “elders of the tribe.” [7] It appears that we can use electronic communication to foster such healthy intergenerational relationships built on respect, friendship, and care, while encouraging this “sage-ing” development in the elderly. Elders and youth can use an electronic environment, like video-conferencing, to explore remote relationships in which the life experiences of the elderly are utilized by the youth. We call this process “e-sage-ing.” In particular, e-sage-ing can be a mechanism for the elderly and disabled who are homebound and perhaps isolated to communicate with kids who are home alone while their parents work. In this way, both parties contribute to these interactions and can add value to society through teaching, learning, discovering, exploring, caring, and mentoring. We propose that electronic communication in an intergenerational workplace, home, and community can enable lifelong contribution to society.

Another example of technology contributing to wellness can be seen in the work of Dr. Dave Warner of the Institute for Interventional Informatics. [8] In one of his many applications for the disabled, he used a remote controlled toy car, equipped with camera, to allow a severely disabled child to “play” with friends in his home, even though he was confined to bed. [9] The child’s friends played with the car while he controlled the car and viewed the activity with the friends, using the “vision” provided by the camera on the car. One can imagine such a device allowing an aging grandparent to remotely interact with and monitor the activities of a grandchild.

Technology also can provide a means for the individual to monitor his or her own health, promoting adherence to drug and exercise regimes and alerting the individual as well as caregivers when physiological indicators show significant deviance from established baselines. There are many products coming on the market today to enable this kind of personal monitoring. For example, a website offered by BodyMedia, Inc. [10] allows individuals to enter data about their physiological state and mental state and then provides feedback on their total health status. Wearable monitors to collect much of this data directly from individuals will be available for their customers later this year and will allow download of the data to their site for analysis. Currently, some health clubs have their exercise equipment networked, allowing clients who sign in at each piece of equipment to track their progress in a given session and compare to previous sessions. This can serve as a motivational tool to follow a prescribed exercise program. In the future, perhaps we can have monetary incentives through lower rates for medical insurance when technology is used to monitor and document adherence to a healthy regimen.

We suggest then, that there is a significant role for technology to play in the delivery of social support and other wellness interventions—that appropriately developed and deployed technologies can enhance rather than substitute for the human dimension of caregiving. Technology can do this by performing certain tasks that do not require a human dimension, such as routine monitoring and record keeping, thus freeing caregivers for attention to more important social interactions. In addition, technology can enhance or expand certain types of social interaction. Moreover, given the pending shortage of labor as the elderly population increases relative to the caregiving population, such technological enhancement of human interaction will be imperative if the quality of life of the elderly is to be maintained.

Improve the efficiency of consumption

As we move towards a future in which the amount that we can afford to spend per capita on healthcare begins to shrink, it is vitally important that we find ways to avoid wasting funds. It is well understood that the least knowledgeable consumers of healthcare tend to be some of the most expensive users. It is therefore in our best interest to educate our seniors on how and when to make use of healthcare services and to enable them to do for themselves many things for which they might otherwise turn to professional caregivers.

One example of this sort of education is found at the Palo Alto Veteran's Administration (VA) Hospital. The hospital has a grant to study the usefulness of presenting computer-mediated healthcare information to patients via kiosks in waiting rooms and other public spaces. The kiosks will be placed in public spaces to allow patients to access health information from the 20 best health-related websites in the controlled environment of a touch screen kiosk. Patients will be able to refill their medications online at the kiosk, print health information, and fill out online surveys that will provide demographic information. The kiosks will also print vouchers for medical attention and will track the patients' compliance with the recommended clinical care.

The Health Buddy (developed by Health Hero Network) is another technology being evaluated by the VA. [11] The Health Buddy is a tabletop device about the size of a caller ID box that connects patients with their caregivers. Caregivers and patients are able to “converse” in real-time or asynchronously about a patient's progress. The caregiver regularly reviews a web-based database on the patient's progress, and later any relevant changes in progress are communicated to the primary care physician. Health Buddy features a simple interface that is easy to use. Trends the VA Hospital has noticed from patients using the Health Buddy include reduced hospital visits, increased access for veterans in rural areas to services, increased provider satisfaction, increased patient satisfaction, reduced medication use, enhanced patient education, improved self-management, and improved acceptance of technology. Patients are provided a Health Buddy tailored to their special needs. Health Hero Network has various Health Buddies dealing with conditions such as stress, anxiety, diabetes, lung disease, and heart disease.

A third example of a technology aimed at improving efficiency is the “problem knowledge coupler” developed by Dr. Larry Weed, one of the leading thinkers regarding the use of information technology in medicine. Drawing on the fact that computers can retain facts much better than humans, Dr. Weed's problem knowledge couplers allow doctors to do what they do best—observe and examine a patient—and leave the task of matching presenting signs and symptoms to known medical conditions (i.e., diagnosing) to the computer. Dr. Weed cites a case history, published in the *Journal of the American Medical Association*, of a woman whose physicians took seven months of numerous examinations and tests to diagnose her. The problem knowledge coupler took seconds to arrive at the same conclusion.

Reduce the cost of providing a benefit

In this final strategy for addressing the consumption side of the supply-demand equation, our goal is to find ways to derive more benefit for every dollar that we spend. This is exactly what is being done in certain parts of the healthcare community today, where changes are being made in who does certain tasks and where these tasks are performed. By prudent shifting of tasks, delivery systems within the healthcare community are making it cheaper to provide certain services.

One example of research in this area that has the potential to aid the elderly is Georgia Tech's “Aware Home.”[12] Using non-intrusive tracking devices that monitor movement about the home, researchers can provide reassurance to caregivers without intrusive telephone calls or other contact with the resident. A more extensive, commercially available example can be found in Elite Care [13] in Milwaukie, Oregon. Elite Care operates Oatfield Estates, an assisted living facility, in which an infrared monitoring system enables the computer network system to determine the location of each resident and caregiver. The all-electronic care records kept on the system are accessible in each room only to the appropriate personnel, determined automatically by the system's knowledge of the personnel in the room. The movement of caregivers throughout the facility is noted, allowing for more accurate

records of care actually delivered. Computer-controls allow activation of proper lighting for each resident and deactivation of appliances that could harm residents with dementia. Sensors in the beds of residents allow an unobtrusive weight tracking of each resident, and in combination with location data, permit automatic calls for caregiver attention if a resident is not in bed during normal sleep times. Caregivers also live with their families in this facility, providing an extended family setting. The technology enables fewer staff with a more continuous presence.

Finally, telemedicine in its many variants also fits into this category. Distance consultation already is a reality, precluding fatiguing journeys for the elderly, freeing up escort or support personnel and services, and providing access to a broad range of expertise particularly for those living in geographically remote areas. Advances in haptics and robotics are bringing the notion of remotely performed surgery into the realm of possibility. [14] In a study conducted in North Carolina by Bonnie Britton, this technology was found to lower the overall cost of care while maintaining its quality. Britton replaced in-person home care nursing visits with a combination of in-person and telemedicine-based visits. Using a telemedicine station placed in a patient's home, nurses could videoconference with the patient and collect physiological measurements. With this technology, the nurses were able to quickly assess which patients might need an in-person visit, which were doing well, and which might have required hospitalization. The study proved an outstanding success with patient satisfaction running at 90 percent and the cost of delivering care dropping by nearly 50 percent. These sorts of results have been replicated in studies conducted in other parts of the U.S. as well.

A Model for Tomorrow

While we can show instances where specific technologies have reduced the need to consume, made consumption more efficient, and reduced the cost of providing benefits, significantly reducing consumption of healthcare resources will require a substantial shift in thinking on the part of the existing care delivery institutions. Given that large institutions, like our healthcare systems, are always resistant to change, what reason do we have for believing that we can affect the kinds of changes that we are discussing here? Is there a precedent that would lead us to believe these institutions might be willing partners in shaping this future? Fortunately, the history of diabetes care provides us with an example of a place where such a change has already occurred in the healthcare community.

Fifty years ago, patients who developed diabetes were fully dependent on healthcare professionals to meet all of their needs. All clinical testing of any significance took place in the doctor's office; all knowledge regarding the patient's condition and all decisions regarding how to treat the patient belonged to the doctor. The patient, as the diabetic, was to adhere to whatever treatment regimen the doctor established, but was not really considered a part of the solution to the health problem. In the last few decades, however, the model of care has shifted from dependence to empowerment. As Dr. Oscar Crofford, former president of the American Diabetes Association notes:

"Today, patients are taking much more responsibility for their own health. This change in attitude has profoundly changed everything. The medical team is now perceived to be there to provide the understanding and training to equip patients to care for themselves. Technology is there to provide the necessary tools. Society is there to provide the financial resources to make self-care possible." [15]

Note the principles here: the patient is responsible, the medical team equips, technology enables, and society supports. This is a pattern that we can apply widely.

Today, when patients are diagnosed with diabetes, the top priority of the medical community is to teach them to manage their own conditions (as with many chronic conditions that afflict the elderly, there is no "fixing it" here). Since the onset of other pathologies caused by diabetes can be significantly delayed and their effects mitigated, this strategy *reduces the need for consumption*. With effective self-care for diabetics, the odds are in favor of a longer and more productive life. As part of the process, diabetics are assigned nurse educators who teach them about the normal progress of the disease, about how to manage their own care (including routine clinical testing such as blood glucose monitoring), and about how and when they should introduce themselves into the care delivery system. Consequently, *the efficiency of the care system is improved*. Finally, as the responsibilities that were once laid on the doctors are shifted to nurses, dieticians and to the patients themselves, *the cost of providing the health benefit is reduced*.

Making this New World a Reality

Research on many of these technologies is underway in National Laboratories and in the laboratories of industry and universities. There is a long road, however, from the laboratory to the marketplace to the care environment. We at this conference and our peers and colleagues back home have much we can do to make this road shorter and easier to travel.

We can recognize and promote the importance of a nationally coordinated science and technology policy. In many countries, including ours, science and technology policy is a de facto result of decisions made in other arenas. The budget is fragmented and uncoordinated. Formalizing and integrating these decisions so they can leverage one another will allow us to get the greatest return on our investment in this arena. It is also important that we invest in multi-disciplinary science and technology research, supporting not just the life sciences but also engineering, information technology, and the behavioral sciences.

An interdisciplinary area of great significance is that of research on cognition and the aging mind. The U.S. National Research Council recently recommended major research initiatives in three areas: build the scientific basis for promoting neural health in the aging brain; understand the effects of behavioral, social, cultural, and technological context on the cognitive function and life performance of aging individuals; and improve our understanding of the structure of the aging mind. [16] If we increase our understanding of these three areas, we can design multi-faceted prevention or intervention regimes that could profoundly change the character of our aging society.

As part of this national investment in science and technology, we also need to look at the way in which we educate caregivers. Historically social support and technology-literate workers have followed different institutional and programmatic tracks in their training programs. Engineers who design wearables to allow the elderly to monitor their own health traditionally have had little training in the psychology of dependency and other areas of geriatric social work that might influence the elderly's use of the devices and interpretation of the results. Conversely, those trained in social support vehicles and delivery mechanisms generally have a low level of awareness of technologies available to enhance interactions and little training in the use or repair of such devices. Cross training will be key to the development of effective, useable devices.

We need to work with our regulatory and reimbursement structures to create provisions for technology-based clinical trials or early deployment of technologies for health care. Distance medicine providers in the early days of telemedicine, for example, had difficulty getting paid because a videoconference with a patient did not qualify as an "office visit." The technology was there; the social ability to field it was not. This is another area on which we can have influence.

A related charge to you all is to build or modify reimbursement structures so that they can accommodate the wellness approach. As the financial returns to an insurance provider from a covered individual who engages in a wellness regime are not realized for many years, an insurance model that allows these individuals to change providers frequently will not be financially attractive. Restructuring and revising the insurance provision industry will be a task of tremendous difficulty—but it is one that must be addressed.

Conclusion

We will all experience chronological progression—we will all "age" in a narrow sense of the word. However, we do not need to "grow old" in the ways that we are now. A judicious combination of technology and social support, deployed within an appropriate regulatory and payment environment, can enable us all to enjoy a high quality of life as we age. As Matsushita said,

"...there is hope you may die young at eighty."

-
- [1] Peterson, P., "Gray Dawn: The Global Aging Crisis", *Foreign Affairs*, January/February 1999, pp. 42-55.
- [2] "Managing the Global Aging Transition," CSIS Policy Summit of the Global Aging Initiative, held January 22-24, 2001, in Zurich.
- [3] "MHS 2025 – Toward a New Enterprise", December, 1999; available at <http://mhs2025.sra.com/enterprise.htm>
- [4] www.nationalwellness.org
- [5] Cowman, Carl W., *Homeostatic Processes in Brain Aging: The Role of Apoptosis, Inflammation, and Oxidative Stress in Regulating Healthy Neural Circuitry in Aging Brain*, The Aging Mind: Opportunities in Cognitive Research, National Research Council Committee on Future Directions for Cognitive Research on Aging, Paul C. Stern and Laura L. Carstensen, editors. Washington, DC, National Academy Press, Page 115.
- [6] www.generationsonline.com
- [7] Schahter-Shalomi, Z and Miller, R., *From Age-ing to Sage-ing: A Profound New Vision of Growing Older*, Warner Books, 1997.
- [8] www.pulsar.org.
- [9] Presentation at Sandia National Laboratories, September 1999.
- [10] www.bodymedia.com
- [11] www.healthhero.com
- [12] <http://www.cc.gatech.edu/fce/ahri>
- [13] www.elitecare.com
- [14] "In the Waiting Room", *Scientific American*, December 2000, [http://www.sciam.com/2000/1200 issue/1200techbus1.html](http://www.sciam.com/2000/1200%20issue/1200techbus1.html)
- [15] Crofford, O., M.D. *Diabetes Care Then and Now*, Diabetes Forecast, November 1998.
- [16] The Aging Mind: Opportunities in Cognitive Research, National Research Council Committee on Future Directions for Cognitive Research on Aging, Paul C. Stern and Laura L. Carstensen, editors. Washington, DC, National Academy Press Pages 2-3.